IoT Based Automatic Billing System Using Barcode Scanner by Android Device and Monitoring Unregistered Barcode by RFID

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***Abstract*— In all over the world India is the second largest populated country. People here like to shop their daily needs in malls because of the quality of service they provide to the consumers. The main problem that we face here is having to wait for long queues even to bill one or two products or at times there might be problems with several other billing counters which would temporarily be out of service and all must go through the billing process only at one remaining counter. In this paper, we will discuss about the solution for various problems arising in the malls such as time consuming while billing, miscounting, thefts and other such discrepancy. We are implementing an automatic billing system which helps us to solve all the problems as mentioned above with the help of RFID scanners and detector for scanning of products and prevention in theft and IoT for data management purpose. It not only makes the billing system easier, it also helps us to transmit billing information to customer's mobile and automatic detection of amount from their interlinked bank account.**

Keywords—- IoT, RFID scanner, RFID detector, gateway

I. *INTRODUCTION*

As discussed by Fredy. J. Valente etc in their paper RFID tags were attached to steel beams, so that the steel beams could be easily identified over a distance of up to 7 meters [1]. When metals are subjected to radiations they reflect, this problem is solved here by using a positioning system and an innovative RFID tag filtering based on the combination of Doppler effect and Position sensor information captured from overhead crane control box which scans and identifies the steel beams correctly [2], [3]. Once there is a purchase order from the customer on ERP the list of the material is sent to over- head crane and the same would be loaded to the truck in the warehouse. Before the use of RFID tags barcode tags were glued on steel beams but the main problem here was monitoring the loss and displacement of steel beams became very tough and speed of work was dependent on the skill of the crane operator [4]. Thus, this led to automation in warehouse using RFID technology. Tadeusz Nowicki etc in their idea have attached RFID tags to the important documents which are restricted for access to administrative office only [5]. Since the size of the tags were very small of approximately 10 cm^2 it can be easily attached to the required documents. When the tags are subjected to radiations some waves are generated and they send some signals to certain distance which is monitored. It can mainly have an account on increase or decrease in count of documents and their misplacement [6]. All these analysis is achieved from simulation method, thus avoiding malpractices that occur in administrative offices. Also, S Amendola etc have discussed about the use of (Ultra High Frequency) UHF RFID technology which offers protection to infrastructures like smart grids, power plant and Pipe lines etc. from physical threats and unusual variation of environmental parameters [7].

The space under observation was associated to a RFID reader connected to multiple transmitting and receiving antennas along with sensors. Each of these RFID antennas had tags or transponders which convert the sensed signal into digital form or any convenient form, enough for us to detect the threat. Even Jingming Zheng Yang discussed about the multiple port reader antenna with 3 modes for UHF RFID applications. The RFID technology used here by them replaces the normal antennas which were using unique radiation properties separately for (Near Field Communication) NFC and far field communication with a special antenna having multiple radiation properties for both NFC and far field communication simultaneously [8]. Their designed antenna had 3 ports in its internal structure which were responsible for providing multiple radiation properties based on the user's application [9]. Micheal Longhi etc said that RFID and UAV (Unmanned Aerial Vehicle) technologies can be merged to measure risky conditions and prevent dangerous events to manage post disaster scenarios [10]. RFID attached to UAV provide the interrogation of sensor tags displaced over the earth by means of a reader installed on board, which is used to monitor safety of construction animals' surveillance [11]. Ruinian Li etc in their paper said that in this system all items for sale were attached with an RFID tag, so that they can be tracked by any device equipped with an RFID reader in store [12]. Here the shelves, shopping carts have been put up with RFID readers [13]. They have used ECC based cryptosystems as key size is smaller when compared to other cryptosystems as the smart card need low energy consumption of IoT and needs to be light weight asymmetric for signing and encrypting to protect confidentiality and integrity.

Thiago Manuel Fortunato da Costa etc in their paper mainly aim to embark RFID technology allied to other technologies in both hardware and software framework, consisting of embedded system for use in industries with the objective for identifying blocks in shipyard by reducing time and money invested [14]. Here IoT is use to communicate With other nodes of network with the intention of transmitting the captured data [15]. RFID is used to identify objects or people through radio frequency waves [16]. Here the RFID tags are placed on base line of blocks, and the movement of blocks is followed the with the help of GPS and RFID location of blocks can be noted Marilena Ianculescu etc have used IoT and RFID in main domains required in our daily life. In medicine field, the senior patients who are suffering from Alzheimer disease are given with RFID wrist band which is worn by the patients so that the doctor can keep

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a track over the location of patients if they are heading towards the unsafe area whose indication is given by a buzzer [17]. In agro-food sectors RFID is used for tracing. Here the RFID tags are put to wheat flour bags from the production stage to marketing activities i.e., the entire management of supply chain is monitored with the help of RFID and internet, as RFID readers can identify and track objects. Jaime Lloret discussed in their paper about the integration of intelligent measuring devices and IoT which would provide path for a smart city [18]. They have also used the information technology, with a goal of achieving better management of electric energy, water and gas providing networks and an efficient balance between demand and consumption. Their key technological element is smart meters. According to them smart metering system allows water and gas utilities continuous consumption reading and recording in time intervals, which enables daily reporting, monitoring and billing by enabling 2 way real time communication between meter and utility centred system.

This in turn reduces the labour demand, speeds up process and provides better work management [19]. Even Philip Asuquo discussed about the LBS (Location Based Services) as to, though they were providing users with relevant information based on their location and had desirable features, the locations of users were not protected. As a solution to this they looked for an enhanced privacy technology using IoT which would connect millions of vehicles, enabling them to exchange information including location of drivers for various purposes including road safety, traffic management etc through a complex vehicular network infrastructure to form IOV's (Internet of Vehicles). Prateek Anand in his paper has given an idea about enhancing M2M (Machine to Machine) to give evolved IoT, equating the agenda of M2M and IoT. Here IoT connects millions and trillions of devices to sense information and take actions without human intervention. On the other hand M2M uses a device such as sensor or meter to capture an event which is relayed through a network (wired or wireless) to an application (software program) that translates the captured event into meaningful information which can trigger an actuation and hence has wide variety of application domains like health care, smart grid, military etc. Ramin Sadr etc have discussed about the new class of receiver sub systems is introduced to enhance the performance of detection of signals in wireless sensor networks. The receiver design is applicable for detection of signals from any active or passive sensors and ideal specifically for passive RFID tags. This class of digital packet radio's is an essential ingredient to provide wide area RFID reader systems and gateways and access points for collecting data from new generation of emerging IoT and sensor devices. Kain Fan has discussed about the disclosure of traditional medical privacy data which can be easily leaked to insurance companies which can be avoided by RFID [20]. With the continuous improvement of cloud computing and big data technologies of IoT, the application of RFID system to medical system can efficiently solve this Problem of medical privacy. RFID tags collets useful information and conduct data exchange and processing with back end sensor through the reader. The entire article presents light weight RFID medical privacy protection scheme. The security analysis and evaluation about the scheme indicates that the protocol can effectively prevent the risk of medical privacy data being easily leaked.

II. *ARCHITECTURE OF AUTOMATIC BILLING SYSTEM*

To generalize the billing information, we are storing all information in a data base. Figure 1 shows the block diagram of a RFID scanning and Billing system. The data base can be accessed by interlinked PC's. Each product will be tagged with RFID or QR code or bar code. Each code will be having different identification. The information of the code will be stored in a web data base and is locked. There are two data base, one is Main data base and the other one is Current billing data base. Once the product gets scanned by using an android device (smart phone), installed with our app supporting the scanning process, the barcode will be compared with the main data base, if the main data base is having the scanned product's QR code that product will be added to current billing data base.

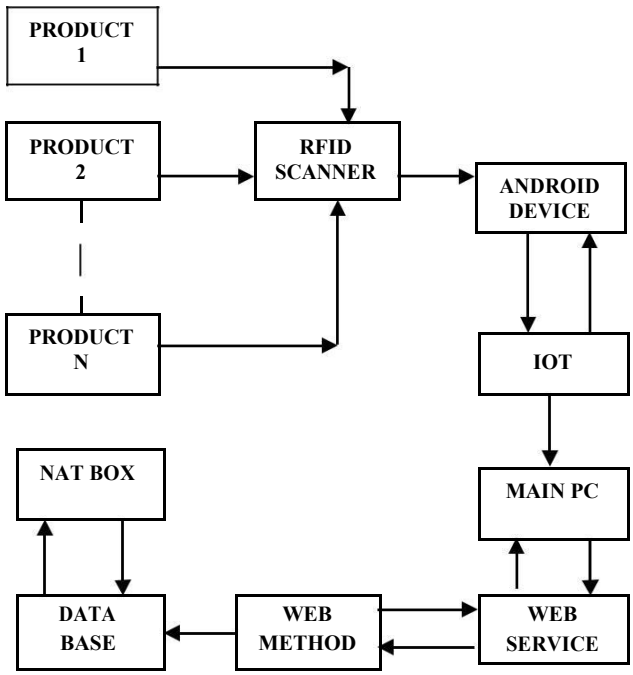

Fig 1. RFID Scanning and Billing System.

If the same customer purchases more, the current billing data base gets updated immediately. If the product's QR code is not there in the main data base, then that product is neglected and it won't be updated in the current billing data base. Once the current billing data base is updated it will be shared with all other PC's. The scanned product's name will be displayed on the screen to make it user friendly. If the customer wants to delete a scanned product

From his/her list, he/she needs to select the product name from the list which is to be deleted and click on delete option provided by our app. In android device, the segregated product names are sent to current data base. Here the current data base relates to the router the specific web service and web data base. We can give the connection from any client to the NAT boxes.

Once the client enter the mall he will be given a specific password and this password is valid until the customer exit the mall .Once the client switch on the Wi-Fi the user name of the client will be displayed on the client android mobile phone and he can connect to the server which is assigned to him with the help of the password .Server will automatically create space in the data base in the name of customer mobile number .Once the specific space has been created in the data base each scanned RFID will be stored in current data base and equivalent product amount will be added to the chart .If one product is taken more than once and if the products first five number of the code matches with the previous one ,then the product count gets increased. If the multiple product count must be decreased, then the customer has to click on product name then select the option of decrease or reduce the count.

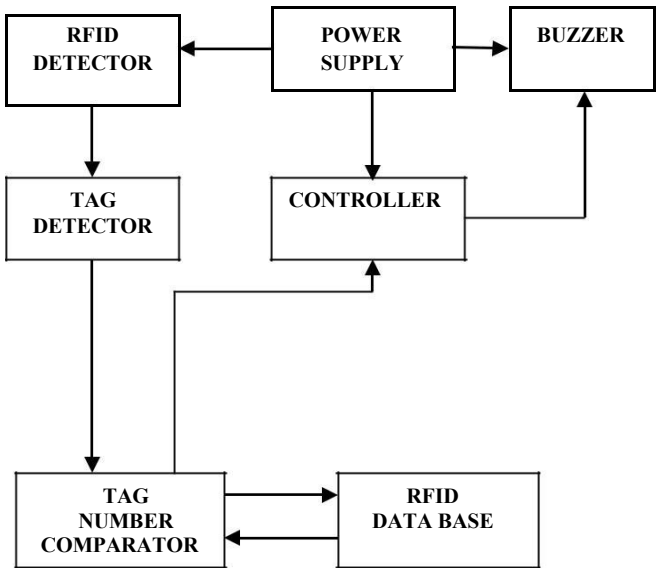

Fig 2. RFID Detector and Alarm System

Once all the product got chosen by the customer once he enter to the billing section he needs to say the mobile number the same will be typed in the billing section. Once the current billing section data base gets the customer mobile number. The customer mobile number will be compared with the space created ID number .Current data base will link with all the information in main data base and the information is fetched regarding the products with the help of RFID tag number .The bill be generated and for the payment option we have three options the customer's android device has the Option to put the OTP and pay or if the customer bank is already linked then the amount will be deducted or the customer can pay by swiping the card. If the customer has chosen OTP option then that option will be present in the android app, directly enter the OTP sent by the bank and click on OK. If the customer's bank account is already linked, then payment is done automatically. If he has chosen card option, the customer must swipe the card. Once the payment is confirmed by the customer that customer product RFID data stored in the main data base will get deleted and that place is reserved to another new product. To avoid the theft RFID detectors are placed at the exit gate once. the customer passes through that gate all the product RFID gets scanned the same RFID number will be compared with the data stored in current data base if any unlocked RFID tag is present the burglar is on. Figure 2 shows the RFID detector and Alarm System After billing once the customer passes the RFID gates, the RFID detector detects the RFID tags and takes RFID tag number. If any product doesn't have RFID tag it will take products' QR code or bar code ID. The same will be passed to the comparator, and then RFID comparator will fetch the data from RFID data base and start comparing with the RFID number. In RFID data base, only billed RFID tags will be stored if any product is having unbilled RFID barcode that will be detected by the RFID comparator and the same RFID number will be sent to the controller and controller will activate the buzzer. Buzzer will be on until it is manually turned off.

III. *ALGORITHM FLOW OF SCANNING AND BILLING*

Figure 3 shows the algorithm flow for scanning and billing of products. Here the system can work as client and server. Client system is installed in customer mobile and server system will be installed in PC for billing system. Once the app is opened on the screen it will display the available server around the Wi-Fi range. It is customers' job to select which server he/she wants connect. In our system once customer chooses the server, server gets connected with the client. Now client should activate the RFID scanner linked with the app. Once the product gets scanned check whether the RFID number got added or product name got added to checklist. If it's not added, scan until it gets added. If it gets added process the RFID number, identify the RFID number and start comparing the number with current data base which is in server. Identify the equivalent product name and add to the check list. If the customer wants to delete the product, he /she should scan the product once again and automatically delete option will be displayed, click on delete option and end the process. If it's acting as a server waiting for a client to connect, once the client asks for the connection compare the client password with the stored data, if it is matched then until the product chart is received it continuously ask for the product hart. Once the product c chart is received search the equivalent amount for the product and make complete bill read while billing start fetching the blank details, if the bank details are found, process the bill or else wait for the bank details.

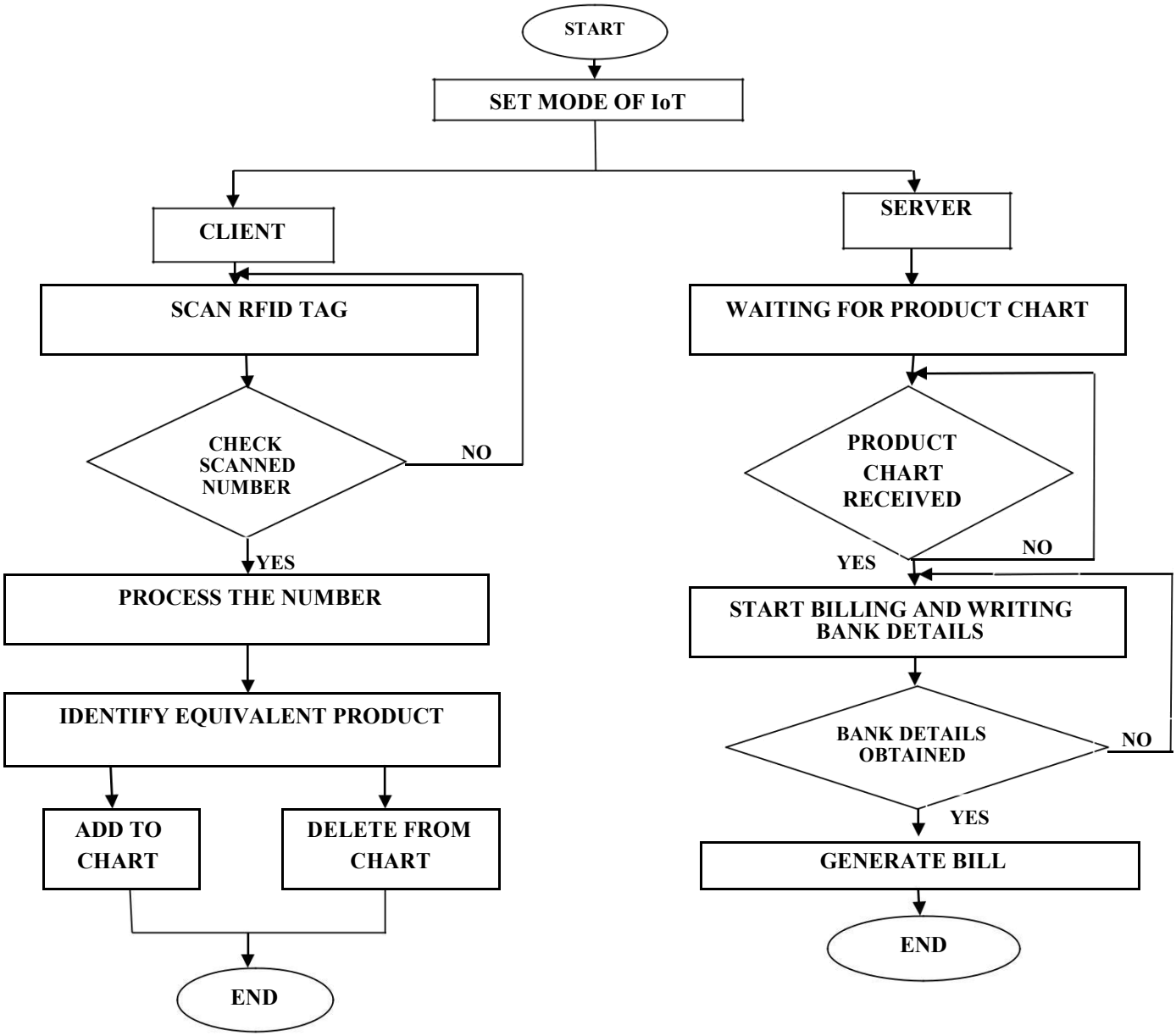

Fig 3. Algorithm flow for scanning and billing of product

IV. RESULT AND DISCUSSION

The methodology that we have followed here is that once the customer is done with the shopping as per their check list one has to scan their own purchased products with the help of their android phone through the app provided. The entire list will be now present on the mobile screen and now the customer can proceed to the billing counter to make payment. The simulator used here allowed us to investigate the software used in the office with RFID tags. The basic property of proposed solution is a simulated methodology of RFID document management, document access control and copy control, as well as management of authorized people access. Each steel product is tagged with RFID. The overhead crane can carry several products at once and products can be tracked after they are dispatched from the warehouse to client by using IoT sensors attached to product using integrated RFID/IoT platform developed. IoT based on wide use of improved RFID can sustain innovative solutions such as monitoring object tracing or person tracking in industry and consumer environment.

Real time collected information allow significant savings and improvements. It is also being tested at a shipyard to prove applicability of RFID technology in environment with high level of metallic interface. Also, used in secure smart shopping system utilizing RFID technology. It is the first time that UHF RFID is employed in shopping experience and secured issues are discussed. Also, the authors have used the RFID technology in UHF domain and provided a technological solution for environmental monitoring of critical infrastructures to be protected from both physical threat and cyber-attacks.

Here RFID sensor network and a control software detects hazards and unauthorized access respectively. A better location security by using enhanced privacy technologies that provide location privacy in vehicular and mobile networks. Here IoT technology has been used to collect various forms of data for various purposes including road safety and traffic management. Conventional billing method consumes a lot of time and also involves errors. This can also be a next step to digital India. The entire system requires the following components: RFID detectors, RFID tags, aurdino boards, PC, UART, power supply, connecting and USB cables, adapters and barcode scanner. The entire system would cost may vary around 40,000-50,000 for one unit. Though the investment cost is high, it is cheaper and efficient for longer use. If there is any unbilled or unscanned products the RFID placed at exit gates will give a warning alarm indicating the theft.

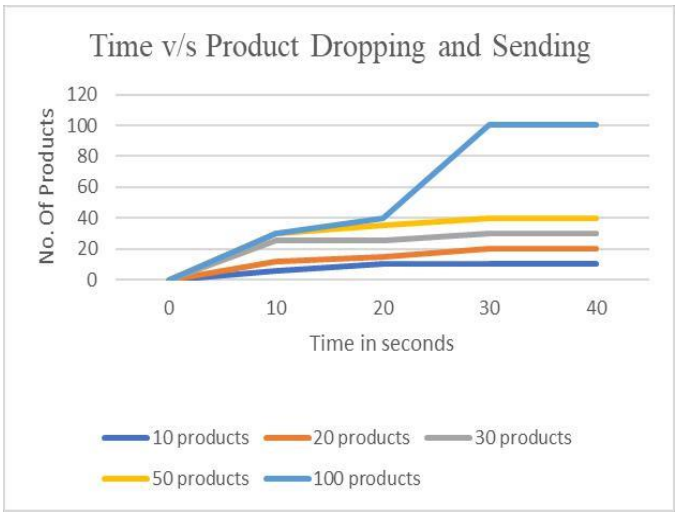

Fig 4. Time period versus product quantity comparison

Figure 4, 5, 6 shows graphical representation of accuracy measurement. Figure 4 shows time v/s product dropping, here we took time cycle from 0 to 40s with difference of 10s and the products from 0 to 120 with the difference of 20 products.

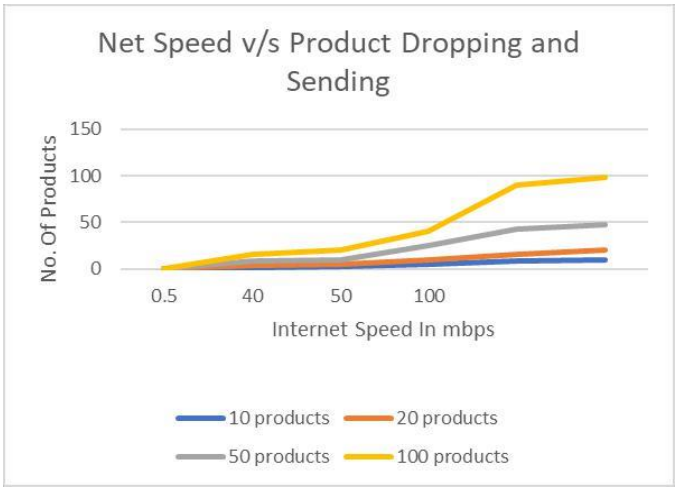

Fig 5. Data speed versus product quantity comparison

At first, we tried to scan 20 products and save the data in the server, initially we kept times as 2s and transmitted the The products to 10 within a few seconds all the data got transmitted and was placed in the database. To check whether we can send more products we increased the number from 20 to 30 products at that time only 24 products got placed in data base, then by this result we conclude that if the product quantity increases, the time required to send that product also increases.

Figure 5 shows the comparison graph of number of product v/s internet speed. To check whether we can send all the data to the data base, we started with 2G mobile data speed. 8-10 products were sent to the data base. On an average 9 products, can be sent. If it is 3G data, then on an average 30 products can be sent to data base remaining are falling or there is a miss of data. Then in 4G and wi-fi with a speed of 10mbps we will be able to send more than 100 products without any drop. Hence, we prefer 4G or wi-fi with 10mbps speed. At the detection side, we have placed RFID detector in the angle of 45^0, because at 45^0 with respect to product we are going to get maximum detection. Figure 6 shows comparison graph between RFID detection range and product detection. If we keep the RFID detector very near i.e., 0.5m it will be able product details, only 4 to 5 products got placed in the data base server and remaining were waiting. Then we increased

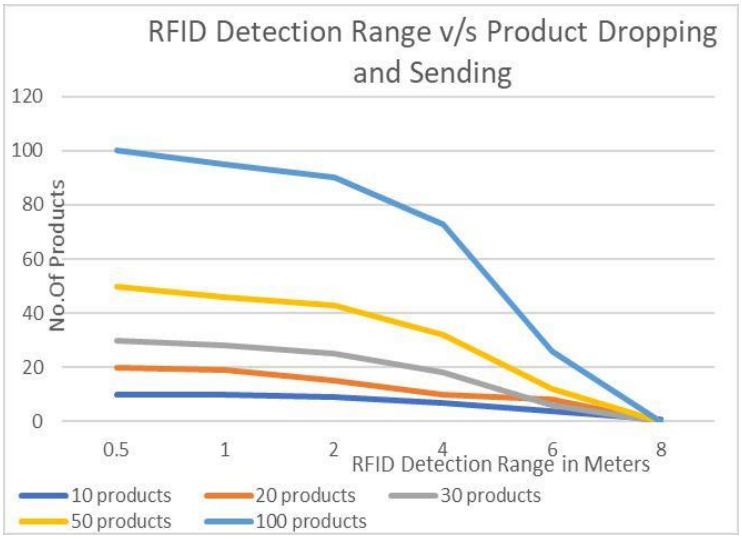

Fig 6. Sensitivity of RFID detector with product

The number of products to 100. As the products are moved away from detector the detection capability decreases.

V. CONCLUSION

Automatic billing system is a set up integration of the IoT and is done because of the low power, low cost system which can be easily designed. It has got very high accuracy due to the plat form of RFID tag and detector. Up to 100 products get scanned and is successfully placed in current database. By the hand shaking technology, it creates the synchronization between the current database and main database to identify the product. If we take the help of Wi-Fi with 10 mbps speed or

4G mobile speed we can transmit the data without any loss for the future work this system can enable very low data speed and very high accuracy.

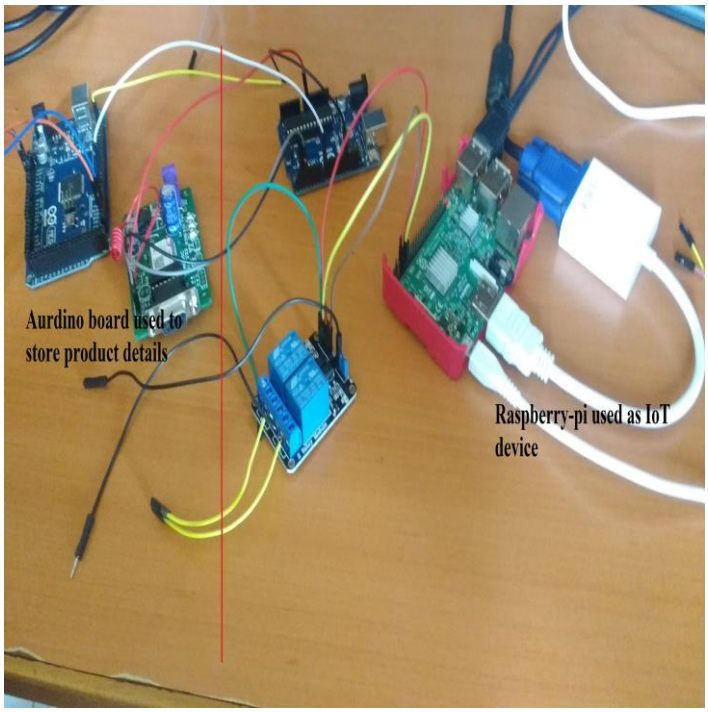

Fig 7. Working model of automatic billing system (prototype)

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